GAVIN NESBITT
36 NEW ROAD
MELBOURN SG8 6BY

E-MAIL GNESBITT@ORANGE.NET

M1BXF

D-Star Part 1

Even if you haven't tried D-Star yet, you will have heard about it as it is growing fast in the UK with new repeaters appearing on air each month.

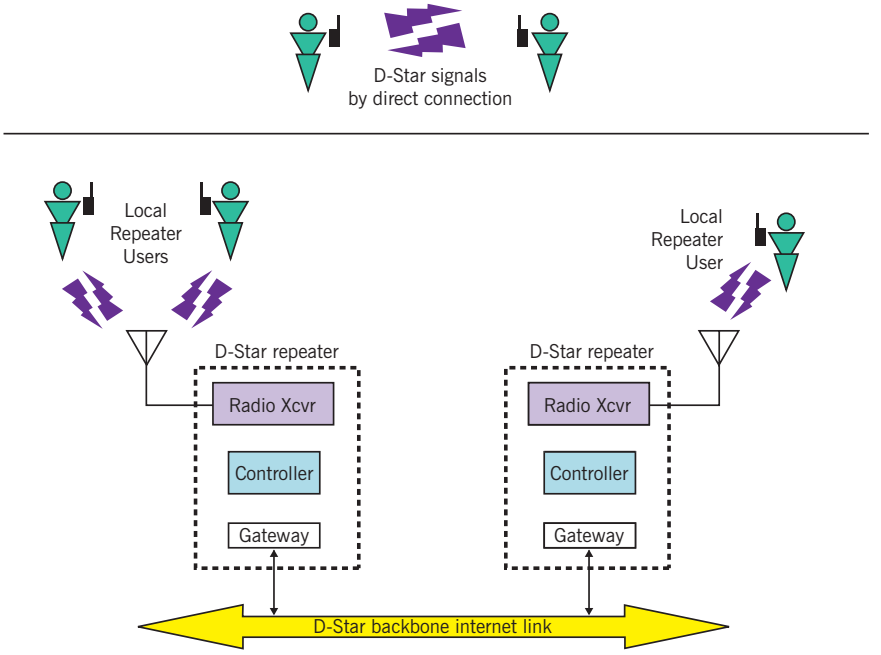

FIGURE 1: D-Star can connect individuals directly, via a local repeater or over large distances over the internet.

A NEW SYSTEM. Imagine a radio system that finds your friends for you: A system where you are able to call CQ on a handheld and making the contact exactly the same whether your friend is next door or on another continent: An amateur radio system that lets you sendpositions reports in a similar way to analogue APRS and other messages without nasty noises on the audio channel. Wouldn't it be fantastic?

Until recently, this sort of connectivity has been the stuff of dreams. But now, D-Star makes it all a reality. It transparently links mobiles, handhelds, home stations and repeaters worldwide, using the Internet. In normal use it simply doesn't matter if your friend is on the local repeater or on holiday miles away, D-Star sorts it all out and lets you communicate effortlessly.

The great thing about D-Star is that you don't have to learn about the technical stuff to operate using it – unless you want to.

OVERVIEW. In my last D-Star article, in the March 2008 *RadCom*, I covered the topic of D-Star very briefly as space was limited. This time round I plan to cover much more of this new and exciting mode, pointing out its strengths and weaknesses, features, usage scenarios and what equipment and projects are available to get you on the air.

The D-Star system consists of individual radios, repeaters, servers known as gateways and internet connections. D-Star repeaters work like standard analogue voice repeaters, with some added bonuses. For a start, they can operate on several bands at once, with 2m and 70cm being most common.

So, what are the fundamentals of getting active on D-Star? First, you'll need a D-Star compatible radio (or DV-Dongle, more of which later). The only people currently making D-Star radios are Icom, although there is nothing to stop others climbing aboard the bandwagon because D-Star is an open standard that anyone can make equipment for.

You need to tell the D-Star radio who you are, which identifies you on the D-Star network. Next, you need to work out who you want to talk to. If you haven't got any D-Star equipped friends yet, just set it to CQCQCQ and someone will come back, just like any other mode.

Finally, you need to make the radio talk to your local repeater by entering its frequency and callsign.

So, the radio knows who you are, who you want to talk to, and the name of the repeater you want to work through. What are you waiting for? Call CQ!

THE BASICS. D-Star stands for Digital Smart Technology for Amateur Radio and was developed by the JARL (Japanese Amateur Radio League) back in 1999 in conjunction with Japanese universities and amateur radio suppliers. Their goal was to advance the hobby into the digital age by developing an open standard, using off the shelf parts, like the AMBE 2020 voice encoder chip, which would allow anyone to design and produce digital radios or interfaces for radio amateurs. So, D-Star was born.

The D-Star standard has two modes. The one causing the most excitement, and the main one used in the UK, is Digital Voice. DV mode allows simultaneous voice and serial data and easily fits in a 12.5kHz channel. The other mode is a high speed digital data mode, DD, which gives a 128kHz half-duplex data connection. DD requires wide channels and is only used on 23cm.

Digital Voice uses a 4800baud data stream. This is split into 3600baud for voice, including 1200baud of error correction, and 1200baud for non-error-corrected data. When DV mode signals are marginal, the first noticeable effects are errors on the 1200baud serial data stream. The voice holds up reasonably well as

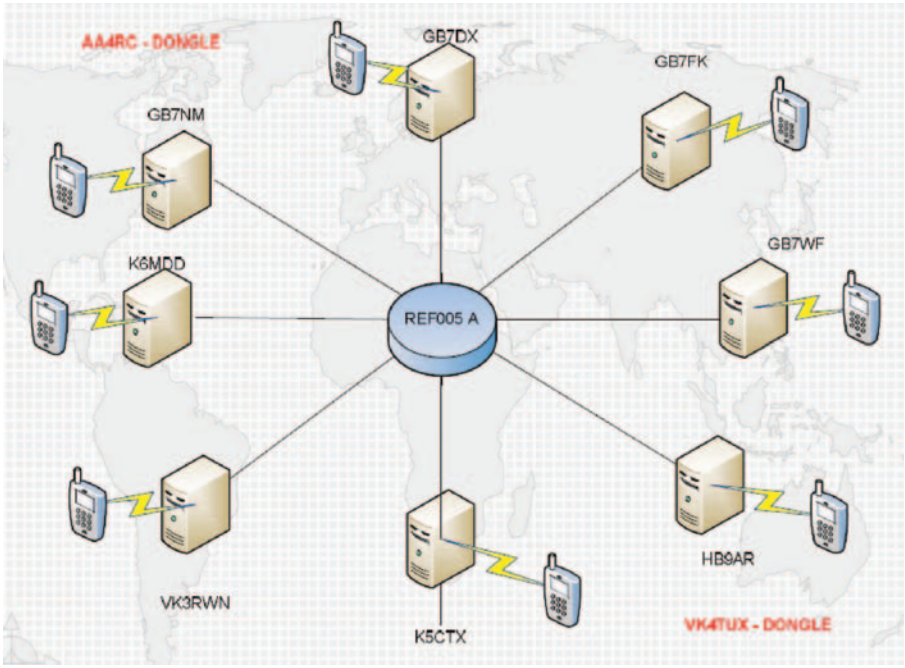

FIGURE 2: Reflectors link D-Star repeaters, RF stations and DV Dongle users from around the world into a single meeting place.

signals degrade further, eventually failing quickly as the signal quality falls below the error correction capability.

Think of D-Star as the transport mechanism, just like the meaning of FM or SSB. It's what you send over it, in DV or DD mode, which makes it interesting. A little like packet radio, packet by itself is useful but using packet for APRS or the DX cluster is what makes packet what it is today. D-Star uses GMSK (Gaussian Minimum Shift Keying) modulation to send the 4800baud data stream over the air. As it is digital, the data stream includes headers such as the route the data should take and where it came from. There are four values that are used for routing and are easily programmed in all the radios available. These are MYCALL, URCALL (sometimes seen as YOURCALL), RPT1 and RPT2. In real life, these are used as follows;

MYCALL: Station/Terminal identifier, this is usually your own callsign but can be any name you wish such as CAR1, USER A, etc. There is no licence requirement for it to be your callsign and this entry is what is used to authenticate and track you on the D-Star network (more later) so using your callsign is favoured.

URCALL: The destination address. Can be another users callsign, a repeater or, if there is no intended recipient, CQCQCQ is used.

RPT1: The callsign of the repeater being accessed, this is used in the same way as CTCSS on analogue repeaters – meaning if you are in range of two D-Star repeaters only the one corresponding to the RPT1 value will trigger.

RPT2: This value is optional, it is only used if you wish to route traffic to a different place such as another local port on a different band, through the gateway if you are connecting to a remote repeater or finding the location of a user and the echo test server – more about this later. All the D-Star radios have these updateable values and, in the case of Icom radios, each memory channel supports having unique URCALL, RPT1 and RPT2 saved alongside other memory data. This means if you can save a channel with the correct values to route to a remote repeater or user and name the channel appropriately.

ADVANTAGES. Being digital is what makes D-Star an interesting mode. It brings all manner of new and enhanced features to radio amateurs such as data and call routing, simultaneous voice and data traffic, web reporting of stats and a real-time last heard list of users on the network. But, it's when in range of a D-Star repeater on the gateway, ie connected to the Internet, that the system provides most of the advantages over analogue repeaters, being able to form a wide area network. A key feature is that the D-Star network can track users last known location in the form of the last repeater and port the user was heard on. This can be used like a cellular system and automatically route calls so, if a station wants to contact another station without knowing where that station is located, the gateway can do a lookup of where that station was last heard and can route the call there automatically. Other features of the gateway are that they are able to connect to reflectors, GPS (DPRS) position reporting to the web and echo test, which is just a simple way to test your transmission. It's worth saying that the gateway has user access control and users must be registered to use its features, there is no access control on using the repeater for local contacts. The main reason for registration is to add your callsign, a MYCALL value, to the gateway that assigns it an ID (an IP address) that is used by all the gateways for tracking and routing calls. Contact your local D-Star repeater keeper or group to be added to the gateway once you get a D-Star radio.

REPEATERS. Currently only Icom have a repeater system available but there are open source repeaters in the pipeline. Icom's repeater controller can support four repeaters, simultaneously associated with three ports, simply known as Port A (same for DV or DD), B or C. The ports are harmonised across the network so the user knows which repeater/band they are connecting to. Normal aliases are Port A for 23cm DV and/or DD, B is 70cm DV and C is 2m DV. There are other ports such as G for the gateway (internet connection) or E for echo test. When routing, you always need to specify the port you are connecting to on a remote repeater and, in Icom's case, the port number always has to be in the 8th position in the URCALL, RPT1 and RPT2 fields. If you start the URCALL with a forward slash '/' this indicates the callsign is that of a repeater and not a user.

Let's look at a few examples of how routing works. If I wanted to connect to another repeater from the 70cm port on GB7PI to, say, the 70cm port on GB7NM (north Manchester) I would set my values as MYCALL = M1BXF, RPT1 = GB7PI B, RPT2 = GB7PI G, URCALL = /GB7NM B. When I transmit with these settings I would be heard locally on the 70cm port of GB7PI and would also be heard, almost instantly, on the 70cm port on GB7NM. If I used this connection a lot, I could save these values in

a memory channel and call it something like GB7NM. If I wanted to call a user directly, I would simply change the URCALL from the above example to the callsign of the station I wish to contact like URCALL = G7LWT. What happens now is the gateway PC does a lookup of G7LWTs last known repeater/port and then routes my transmission to that repeater/port. It's that easy.

If I was just calling locally, I would just need to set RPT1 = GB7PI B and URCALL = CQCQCQ. However, with the advent of reflectors and DV Dongle users it is suggested that everyone put the local gateway into RPT2, this is because DV Dongles and reflectors connect to repeaters as a gateway and not a user so, for your data to be routed back to those connected via reflectors or DV Dongles, you must use the gateway, hence you need to set RPT2 = GB7PI G.

REFLECTORS. I keep mentioning reflectors. Users of echo link, IRLP and eQSO will be familiar with conference rooms and reflectors are the D-Star equivalent. D-Star reflectors were developed by Robin, AA4RC, an amateur in the States who has written lots of enhancement applications for the D-Star gateways, the main one being dPlus, which is the code that reflectors run from. Reflectors link D-Star repeaters, RF stations and DV Dongle users from around the world into a single meeting place. There are reflectors located in many parts of the world and we have two in London, UK, REF005 and REF006. Each has three ports, A, B and C, giving a total of six conference rooms that are used by different European countries or groups.

Connecting to reflectors is simple and only requires the name and port of the required reflector plus an L for link or U for unlink in the URCALL field, ie REF005AL to connect and REF005AU to disconnect. Once connected, an audible announcement is given and the users should then change their URCALL back to CQCQCQ so dPlus doesn't keep trying to connect to the reflector every time you transmit. Again these settings can be saved as a memory channel that can be recalled whenever needed.

DV DONGLE. The DV Dongle is an AMBE2020 chip connected to a computer via a USB interface. DV Tool, the DV Dongle control software, is supported in Windows, Mac and Linux and connects to repeater gateways or reflectors to allow DV Dongle users to speak with D-Star radio users from their computer. As mentioned earlier, it does require remote RF users to have their RPT2 value configured correctly to the gateway port. The DV Dongle is not the same as an Echo Link user sitting at their PC as it connects to the gateway and not a user. In a comparative sense, it's like a link connecting to a repeater. At present, there is no radio used at the DV Dongle end but I believe there are plans to make DV Tool interface into a 9k6 port of an existing radio that will give the user the joy of being RF again.

A collection of D-Star radios.

Don Turner, G4TKR, standing next to one of Icom's D-Star repeaters.

RADIOS AND INTERFACES. As much as D-Star is not Icom's own standard or technology, they are the first and so far only company currently to make D-Star equipment commercially available. At the time of writing there are six different Icom radios available, four mobiles and two handhelds. These comprise of ID-1 for 23cm DD and DV mode, ID-800 for 2m and 70cm DV, IC-2200 for 2m DV, IC-2820 2m and 70cm DV mobiles and IC-E91 and IC-E92 2m and 70cm DV handhelds. All six radios are effectively normal FM radios with D-Star being an optional extra on some and fitted as standard in the other. I've had the chance to play with many of these radios and all are fantastic and feature rich even if just used on FM. Currently, Icom UK are struggling to keep up with demand with some models due to the increasing take-up of D-Star here in the UK and elsewhere in the world. The IC-E2820 was reviewed in the March 2008 issue *RadCom* and the IC-E92 will be reviewed next month.

If buying a radio is not for you then there are many projects appearing in the form of adapters that connect to a 9k6 port in an existing FM radio and allow users to join in on D-Star. A word of caution: not all 9k6 radios are built the same and some have problems with transmitting GMSK. Have a look at http://d-star.dyndns.org for project details.

FORUMS. A final word if you are thinking of D-Star, there are many forums available where you can ask questions or just monitor if you prefer. The UK forum can be found at www.dstar.org.uk.

I hope to meet you on D-Star!